INVITATION TO SUBMIT A RESEARCH PROPOSAL ON AN ASHRAE RESEARCH PROJECT

2025-SP, Whole Building MEP Benchmarking Data Research

Attached is a Request-for-Proposal (RFP) for a project dealing with a subject in which you, or your institution have expressed interest. Should you decide not to submit a proposal, please circulate it to any colleague who might have interest in this subject.

Sponsoring Committee: Center of Excellence for Building Decarbonization (CEBD)

Budget Range: $150,000 may be more or less as determined by value of proposal and competing proposals.

Scheduled Project Start Date: **April 1, 2026** or later.

All proposals must be received at ASHRAE Headquarters by 8:00 AM, EDT, December 15th, 2025. NO EXCEPTIONS, NO EXTENSIONS. Electronic copies must be sent to rpbids@ashrae.org. Electronic signatures must be scanned and added to the file before submitting. The submission title line should read: "2025-SP, Whole Building MEP Benchmarking Data Research" and *"Bidding Institutions Name"* (electronic pdf format, ASHRAE's server will accept up to 10MB)

If you have questions concerning the Project, we suggest you contact one of the individuals listed below:

For Technical Matters
Technical Contact
Tina Brueckner
tinabrueckner@yahoo.com

For Administrative or Procedural Matters:
Manager of Special Projects
Derrick Nesfield
ASHRAE, Inc.
180 Technology Parkway, NW
Peachtree Corners, GA 30092
Phone: 404-636-8400
E-Mail: dnesfield@ashrae.org

Contractors intending to submit a proposal should notify, by mail or e-mail, the Manager of Special Projects by December 1st, 2025, in order that any late or additional information on the RFP may be furnished to them prior to the bid due date. Monday, December 1st is the deadline for submitting technical inquiries.

All proposals must be submitted electronically. Electronic submissions require a PDF file containing the complete proposal preceded by signed copies of the two forms listed below in the order listed below. **ALL electronic proposals are to be sent to rpbids@ashrae.org.**

All other correspondence must be sent to dnesfield@ashrae.org. Hardcopy submissions are not permitted. **In all cases, the proposal must be submitted to ASHRAE by 8:00 AM, EDT, December 15th, 2025. NO EXCEPTIONS, NO EXTENSIONS.**

The following forms (Application for Grant of Funds and the Additional Information form have been combined) must accompany the proposal:

(1) ASHRAE Application for Grant of Funds (electronic signature required) and
(2) Additional Information for Contractors (electronic signature required) ASHRAE Application for Grant of Funds (signed) and

ASHRAE reserves the right to reject any or all bids.

State of the Art (Background)

ASHRAE defines the following: whole-life carbon (WLC) emissions as the total greenhouse gas emissions, including operational carbon emissions and embodied carbon emissions over the life cycle of an asset (e.g., HVAC systems, building physical components and construction materials). Greenhouse gases (GHG) are gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of terrestrial radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapor (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), and ozone (O_3) are the primary GHGs in the Earth's atmosphere. Moreover, there are a number of entirely human-made GHGs in the atmosphere, such as the halocarbons and other chlorine- and bromine-containing substances, dealt with under the Montreal Protocol. Besides CO_2, N_2O and CH_4, the Kyoto Protocol deals with the GHGs sulphur hexafluoride (SF6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs). Decarbonization is the process of removing or reducing GHG.

ASHRAE "Position Document on Building Decarbonization": "...By 2030, the global built environment must at least halve its 2015 GHG emissions, whereby…embodied carbon of new construction is reduced by at least 40%"[4] To achieve this by 2030, we need a robust guide to start standardizing whole life carbon calculation to reach 40% reduction in embodied carbon and net zero operational carbon by 2030. Buildings are major contributors to global greenhouse gas emissions, with the construction and operation of buildings responsible for approximately 40% of annual global CO_2 emissions via building operations (27%) and embodied carbon (13%).[5]

As the operational emissions from high performance buildings continue to drop, accounting for the embodied emissions of construction materials and MEP systems is gaining more importance. Currently, the environmental impacts of MEP systems are usually overlooked since data availability is limited and as a result they are commonly excluded from building life cycle assessments (Dixit, M.K. Life cycle embodied energy analysis of residential buildings: A review of literature to investigate embodied energy parameters. Renew. Sustain. Energy Rev. 2017, 79, 390–413. https://doi.org/10.1016/j.rser.2017.05.051). In addition, MEP materials and systems are installed multiple times over the lifetime of s building leading to higher recurrent impacts by increasing material quantities and embodied carbon (Rodriguez B.X., M. Huang, H. Woo Lee, K. Simonen, J. Ditto, Mechanical, electrical, plumbing and tenant improvements over the building lifetime: Estimating material quantities and embodied carbon for climate change mitigation, Energy and Buildings 2020, 226:110324. https://doi.org/10.1016/j.enbuild.2020.110324).

Available data for embodied carbon emissions of MEP vary significantly as a result of different calculation approaches, system boundaries, and other uncertainties (Vilches, A.; Garcia-Martinez, A.; Sanchez-Montanes, B. Life cycle assessment (LCA) of building refurbishment: A literature review. Energy Build. 2017, 135, 286–301. https://doi.org/10.1016/j.enbuild.2016.11.042). Based on a recent systematic literature review of 37 studies, the median (and mean) values for studies that include both the product stage (A1-A3) and cradle-to-completion stage (A1-A5) of the MEP systems are 40 (49) and 49 (61) $kgCO_2e/m^2$ (8.2 (10.0) and 10.0 (12.5) $lbCO_2e/ft^2$), respectively (Roberts, M., C. Ouellet-Plamondon, P. Raftery, Embodied carbon in mechanical, electrical, and plumbing systems: A critical literature review. Building and Environment 2025, 275: 112823. https://doi.org/10.1016/j.buildenv.2025.112823). This work also recommended that future research should develop system specific benchmarks and reduction strategies.

Despite growing awareness, standardized methodologies for calculating and mitigating embodied carbon emissions from MEP systems remain limited, including in North America, underscoring the need for a cohesive framework to address their substantial environmental impacts. ASHRAE Standard 240P "Evaluating Greenhouse Gas (GHG) and Carbon Emissions in Building Design, Construction and Operation" is being developed to provide a methodology for quantifying embodied GHG emissions along with operational emissions over the life-cycle of buildings, and will provide some of the needed guidance to standardize the calculation process including among the building element categories HVAC systems and equipment, electrical products and systems, and plumbing. Still more comprehensive data are needed for product's emissions factors for the relevant life cycle stages. Specific to UK context, the Royal Institution of Chartered Surveyors, "Whole Life Carbon (WLC) Assessment" 2nd edition (RICS) has "Appendix F

MEP" that frames the MEP calculations and "MEP Supplementary Tables" provides MEP take-offs for commercial and residential shell and core and Cat A.

Justification and Value to ASHRAE

ASHRAE members and other professionals turn to ASHRAE looking for practical data and guidance on how to adapt or access the necessary data, that can be used or integrated in their design and construction practices. Thus, it is imperative that ASHRAE performs a comprehensive review of available data for different building typologies and MEP installations, performs the necessary analysis for the different stages to ensure consistency for WLC analyses, generates new knowledge with LCA for five buildings in each building typology, and use this data to develop benchmarks for practitioners.

The research will focus on generating reliable data for industry stakeholders and standardizing methods to enable scalable, global implementation while addressing regional nuances. This research can provide new information for various stakeholders to improve their Standards, Guidelines, and Handbook Chapters. It will help address ASHRAE Research Strategic Plan objectives to update and adapt to move complex-built environments. The project results will help close the gap of existing knowledge on LCA of MEP systems and strengthen WLC emissions calculations.

Objectives

Overall, this project aims to identify and collect high-quality embodied carbon data and generate new data for building typologies on MEP life carbon emissions to derive practical benchmarks that can be used for WLC analysis. The project shall develop practical guidelines that can be used to facilitate professionals in building design and construction by providing practical information and guidance. The project should be focused on meeting the needs of practitioners.

The objectives of this project are to:

1. **Collect Embodied Carbon and Quantity Take Off Data:** The intent is to collect high-quality (by limiting Uncertainty, as defined by RICS Professional Standard, 2nd edition, 240P, or similar standards) embodied carbon data from existing studies and other published literature, incorporating Environmental Product Declarations (EPDs) from manufacturers and other resources, TM 65 North America, where available for different building typologies and representative MEP systems. Next, the goal is to establish default values and emission factors for MEP components and finally compare carbon benchmarks across typologies to identify high-impact areas. This requires a minimum Level of Design (LOD) 200 Revit models to be procured for each building for quantity takeoffs or actual bill of quantity from construction.
2. **Collect Operational Carbon Data:** The projects should include a completed energy modeling report with end uses and fuel sources denoted in the spirit of whole life carbon or actual energy consumption data. The operational energy values should then be paired with operational carbon grid data projected by the default Reference Study Period (60 years) using the tables from ASHRAE 240P.
3. **Perform Additional Life Cycle Analysis (LCA) Calculations:** Consider 16 commercial building typologies and mid-rise residential and perform calculations for the MEP systems. Each study should be accompanied by the structural and envelope results for the building, for the whole building, whole life carbon context, and comparison. The required output is hourly load calculations, both for reference and to confirm right-sizing of system selection.
4. **Provide Benchmarking:** The project's initial phase aims to conduct pilot studies on 4 of the 16 commercial building typologies for a minimum of four representative ASHRAE climate zones (as defined by ASHRAE Standard 169). Benchmarks will be validated through collaboration with project stakeholders. The data sample size should be five buildings per building typology (this allows for data anonymity upon publishing the data). The initial pilot should focus on selecting the 4 building typologies (including "Mid-Rise Apartments" and "Medium Office").
5. **Develop Practical Guideline:** The project will develop detailed guidelines to support the pilot studies that can be used to facilitate professionals in the design and construction practices by providing practical information and guidance. The material will also facilitate adaptation to different building types in North American context as a start, and eventually be used for more global applications and more diverse building MEP typologies in the long term.

Scope:
The contractor shall demonstrate that they have good knowledge of MEP and existing WLC studies. If the contractor has or plans to seek collaborators (funded or voluntary), those collaborators should be identified in the proposal. If the contract has or plans to support this project with independent funding, that should be identified in the proposal.

1. **Scope:** Develop comprehensive, consistent benchmarking for the whole life carbon of MEP systems across the Department of Energy's 16 commercial building typologies[7] (Office, Retail, School, Warehouse, Restaurant, Hospital, Hotel, Hotel, Midrise Apartment, etc.). Key components should include, but not be limited to, mechanical systems (HVAC, pumps, fans), electrical systems (distribution, lighting), plumbing systems (pipes, fixtures), and fire suppression systems. These studies should include the MEP applicable phases/modules of Life Cycle Assessment, at the very least A1-A3, A4, A5, B1, B2-B3, B4, B5, B6, B7, and C1-C4.
2. **Applicability:** This benchmark database will include detailed guidelines and pilot studies to facilitate practical implementation and adaptation to different building types in the North American context as a start, with global application in mind for the longer term.

Alignment with Industry Standards: The data will align the methodology with existing standards such as ASHRAE 240P, RICS 2nd Edition, ASHRAE 100, and the MEP 2040 'Beginner's Guide to MEP Embodied Carbon'. This ensures scalability for global applications with necessary regional modifications.

Deliverables:

a. Progress and Financial Reports

Progress and Financial Reports, in a form approved by the Society, shall be made to the Society through its Manager of Research and Technical Services at quarterly intervals; specifically, on or before each January 1, April 1, June 10, and October 1 of the contract period.

The following deliverables shall be provided to the Project Monitoring Subcommittee (PMS) as described in the Scope/Technical Approach section above, as they are available:

Furthermore, the Institution's Principal Investigator, subject to the Society's approval, shall, during the period of performance and after the Final Report has been submitted, report in person to the sponsoring CEBD committee at the annual and winter meetings, and be available to answer such questions regarding the research as may arise.

b. Final Report

In support of all Objectives, the researcher shall produce a final written report for the project detailing all work undertaken in the project, including data collection, methodologies used, raw data collected, data analysis, and final results. Create a simplified summary table (1-2 standard paper size pages) for inclusion in the ASHRAE Handbook – HVAC Applications that includes final results from the analysis. Additionally, recommendations for further research and continuous development & updating of this table shall be provided.

1. Embodied Carbon and Quantity Take Off Data: Summarize the analysis of high-quality embodied carbon data for different building typologies and representative MEP systems. Present the derived default values and emission factors for MEP components and compare carbon benchmarks across typologies to identify high-impact areas.

2. Operational Carbon Data: The projects should include a completed energy modeling report with end uses and fuel sources denoted in the spirit of whole life carbon. The operational energy values should then be paired with operational carbon grid data projected by the default Reference Study Period (60 years) using the tables from ASHRAE 240P.

3. Additional Life Cycle Analysis (LCA) Calculations: Each study should be accompanied by the structural and envelope results for the building, for the whole building, whole life carbon context, and comparison. A

required output is hourly load calculations, both for reference and to confirm right-sizing of system selection.

4. Benchmarks: Summarize the results and benchmarks for 16 commercial building typologies and mid-rise apartments at a minimum of four representative ASHRAE climate zones (as defined by ASHRAE Standard 169). The data sample size should exceed six buildings per building typology.

5. Guideline: Detailed guidelines to support pilot studies and ffacilitate professionals in the design and construction practices by providing practical information and guidance that can be adapted to more global applications and diverse building MEP typologies.

Following approval by the PMS and the CEBD in their sole discretion, final copies of the Final Report will be furnished by the Institution as follows:

-An executive summary in a form suitable for wide distribution to the industry and to the public.
-Two copies; one in PDF format and one in Microsoft Word.

d. *Science & Technology for the Built Environment* or ASHRAE Transactions Technical Papers

One or more papers shall be submitted first to the ASHRAE Manager of Research and Technical Services (MORTS) and then to the "ASHRAE Manuscript Central" website-based manuscript review system in a form and containing such information as designated by the Society suitable for publication. Papers specified as deliverables should be submitted as either Research Papers for HVAC&R Research or Technical Paper(s) for ASHRAE Transactions. Research papers contain generalized results of long-term archival value, whereas technical papers are appropriate for applied research of shorter-term value, ASHRAE Conference papers are not acceptable as deliverables from ASHRAE research projects. The paper(s) shall conform to the instructions posted in "Manuscript Central" for an ASHRAE Transactions Technical or HVAC&R Research papers. The paper title shall contain the research project number (2025-SP) at the end of the title in parentheses, e.g., (2025-SP).

All papers or articles prepared in connection with an ASHRAE research project, which are being submitted for inclusion in any ASHRAE publication, shall be submitted through the Manager of Research and Technical Services first and not to the publication's editor or Program Committee.

e. Data

Data is defined in General Condition VI, "DATA"

f. Project Synopsis

A written synopsis totaling approximately 100 words in length and written for a broad technical audience, which documents 1. Main findings of research project, 2. Why findings are significant, and 3. How the findings benefit ASHRAE membership and/or society in general shall be submitted to the Manager of Research and Technical Services by the end of the Agreement term for publication in ASHRAE Insights

The Society may request the Institution submit a technical article suitable for publication in the Society's ASHRAE JOURNAL. This is considered a voluntary submission and not a Deliverable. Technical articles shall be prepared using dual units; e.g., rational inch-pound with equivalent SI units shown parenthetically. SI usage shall be in accordance with IEEE/ASTM Standard SI-10.

Level of Effort

This project is expected to take 16 months of research, data analysis/management, and data point generation. Estimated cost of $150,000

Proposal Evaluation Criteria
Proposals submitted to ASHRAE for this project should include the following minimum information:

No.	Proposal Review Criterion	Weighting Factor
1	Understanding of the work statement and deliverables	15%
2	Proposed methodology and typologies proposed for pilot	25%
3	Experience of proposed personnel assigned to project	25%
4	Past performance with ASHRAE or other similar organizations	5%
5	Project Deliverable Timeline Commitments (approach to work steps	10%
6	Past project experience of similar or related scope	20%

Project Milestones:

No.	Major Project Completion Milestone	Deadline Month
1	Collection of Embodied Carbon and Quantity Take Off Data (2 months)	2
2	Establish default values and emission factors for MEP components and compare carbon benchmarks across typologies to identify high-impact areas (2 months)	4
3	Collection of Operational Carbon Data (4 months)	8
4	Collection of Additional Life Cycle Analysis Scopes (1 months)	9
5	Conduct benchmarking pilot studies on 4 commercial building typologies (5 months)	14
6	Prepare final documentation and report (2 months)	16

References

1. https://www.ashrae.org/file%20library/about/strategic%20plan/2025-28strategicplan.pdf
2. https://oneclicklca.com/en/resources/articles/reducing-mep-embodied-carbon#:~:text=Research%20indicates%20that%20MEP%20carbon,the%20lifetime%20of%20a%20building.
3. https://www.ashrae.org/file%20library/technical%20resources/research/research%20strategic%20plan/research-strategic-plan.pdf
4. https://www.ashrae.org/file%20library/about/ashrae_building_decarbonization_pd_2022.pdf
5. Architecture2030 https://architecture2030.org/2030_challenges/embodied/
6. https://oneclicklca.com/en/resources/articles/reducing-mep-embodied-carbon#:~:text=Research%20indicates%20that%20MEP%20carbon,the%20lifetime%20of%20a%20building.
7. Commercial Reference Buildings. Department of Energy https://www.energy.gov/eere/buildings/commercial-reference-buildings